Palliative Percutaneous Drainage in Malignant Biliary Obstruction
Part 2: Mechanisms and Postprocedure Management

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Abstract Malignant biliary obstruction frequently is associated with pruritus, anorexia, cholangitis, or hyperbilirubinemia; this difficult complication precludes the use of antineoplastic agents that are excreted or metabolized via the liver. In patients with low biliary obstruction, endoscopic stent placement may accomplish drainage of the entire biliary tree without the need for an external device. However, patients with high bile duct obstruction most often require a percutaneous approach to drain the target ducts to maximize drainage and to avoid draining an atrophic segment or lobe. In the first in this series of two articles, the indications for biliary drainage and preprocedure evaluation in malignant biliary obstruction were discussed. This second article describes the mechanisms of percutaneous biliary drainage and postprocedure management, including consideration of possible complications.

Bile duct obstruction is a common phenomenon among patients with liver metastases, periportal adenopathy, and hepatobiliary cancers. Members of a multidisciplinary team work together to manage patients who have unresectable pancreatic, liver, and/or biliary malignancies. These patients often have a short life expectancy and undergo palliative biliary interventions or maneuvers to palliate symptoms and allow administration of chemotherapy.

The first in this series of two articles addressed the role of percutaneous intervention in malignant biliary obstruction and focused on indications for biliary drainage and preprocedure evaluation. This second article describes the mechanics of percutaneous biliary drainage, postprocedure management, and potential complications of these procedures.

Deciding on an Approach for Drainage

An algorithm for the nonsurgical management of malignant biliary obstruction is shown in Figure 1. Patients with low bile duct obstruction first should undergo an attempt at endoscopic drainage, since placement of a single plastic or self-expanding metal stent that drains all bile ducts may be accomplished without the need for an external device or the risks associated with puncturing the liver. When an endoscopic approach is not technically possible, however, due to a prior bilioenteric bypass or gastric outlet obstruction, a percutaneous approach to low bile duct obstruction is indicated.

In high bile duct obstruction, a percutaneous approach is preferable, because the duct(s) draining the most functional liver parenchyma may be targeted. Most often, percutaneous drainage is attempted from the right side, since it allows greater access to the target areas; in addition, the volume of the right side of the liver usually is greater than that of the left.

A left-sided approach to the biliary tree may be considered when an obstructing tumor extends above the hepatic hilus, causing isolation of the right anterior and posterior ducts. The right hepatic duct typically is shorter than is the left and the right is therefore more susceptible to isolation. Because the left hepatic duct generally is longer; therefore, the left liver segments (eg, segments II, III, IV) are less likely to be isolated, allowing for drainage of more functional liver with a single catheter. Similarly, if atrophy or compromise of the portal vein occurs on one side, the patient will derive more benefit from drainage of the functional contralateral hemiliver.

In patients with ascites, a left-sided drainage may be preferable, because ascites often will leak around the catheter and cause skin irritation. This problem is less common with left-sided catheters

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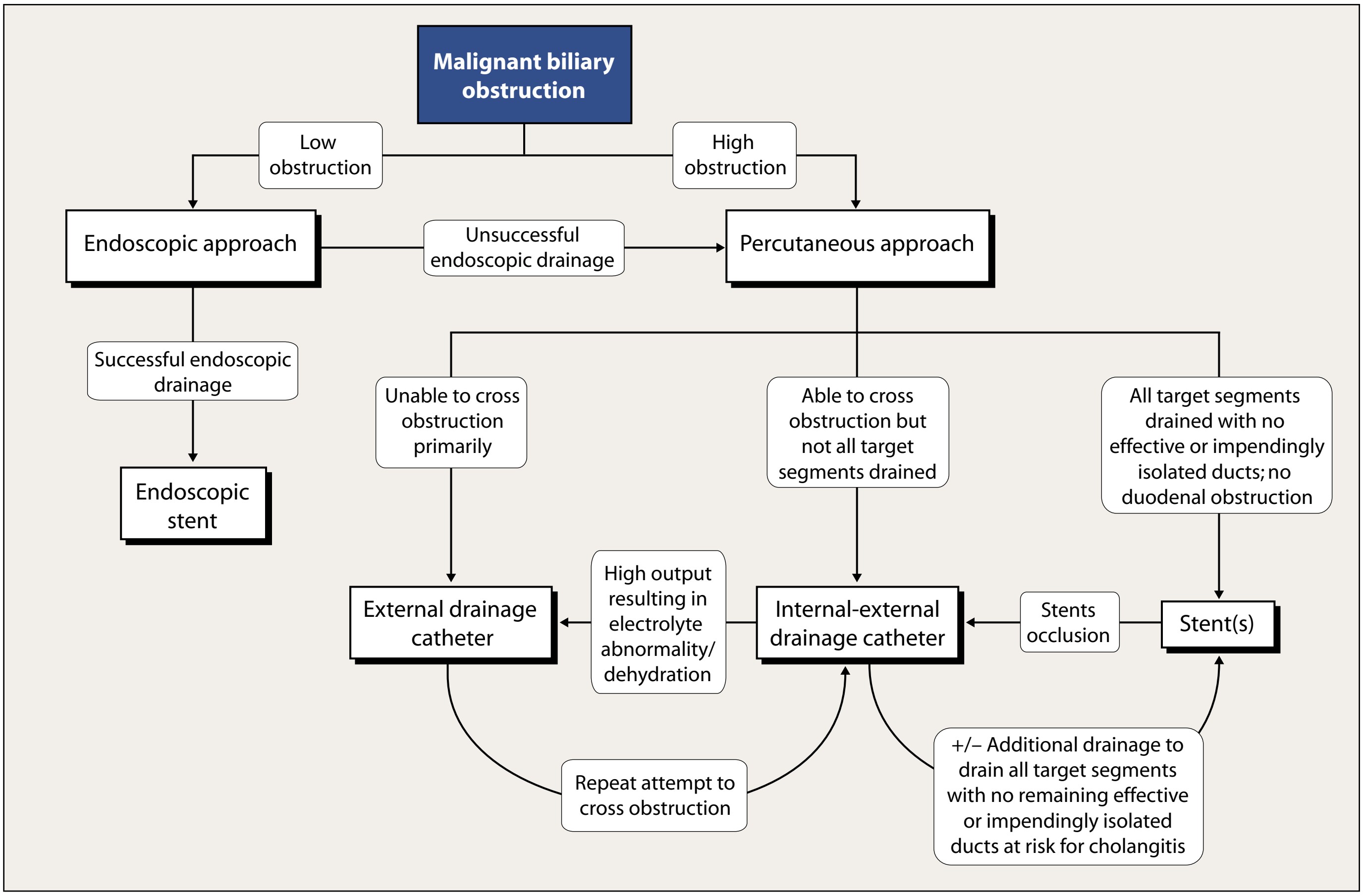

Figure 1 Nonsurgical Management of Malignant Biliary Obstruction

because of the normal distribution of ascites. The approach to the left side of the liver is most often subcostal rather than midaxillary, and because the distribution of ascites is dependent on gravity, the risk and volume of leakage may be minimized by a left-sided drainage.

Finally, intervening viscera or right-sided liver tumors may preclude a right-sided approach.

IMAGE GUIDANCE

Percutaneous biliary drainage is performed with fluoroscopic guidance. Ultrasonography, which is most helpful in a left-sided approach, may be used for the initial puncture of the bile duct.

Careful review of a high-quality computerized tomography (CT) scan is very helpful in identifying radio-opaque landmarks that may be used to target a specific region of the biliary tree or even a specific bile duct. This is particularly important when isolation is suspected and an attempt is made to avoid contaminating regions of the biliary tree that will not be drained.

SEDATION

Biliary drainage is frequently performed with conscious sedation; anesthesia often comprises midazolam combined with a short-acting opioid (eg, fentanyl citrate). To minimize the risk of aspiration, patients should ingest only clear liquids for 4 hours before the procedure. Patients should be well hydrated and have functional venous access for sedation and antibiotic prophylaxis.

Drainage Catheter Versus Primary Stent

The intent of biliary drainage for malignant biliary obstruction is to provide palliation of the patient's clinical problem using as few catheters as possible, with the ultimate goal being internal drainage when the intervention is complete.

Percutaneous biliary drainage can be accomplished using three types of prostheses: an external biliary drainage catheter, an internal-external biliary drainage catheter, and a stent.

External biliary drainage catheters enter a bile duct and sit above the obstruction to drain bile externally into a bag (Figure 2). An internal-external catheter enters a bile duct above the obstruction, crosses the obstruction, and enters the duodenum (in the absence of prior surgery; Figure 3). The internal-external catheter is more stable and provides drainage both into the small bowel and outside into a bag, thereby reestablishing the normal enterohepatic circulation of bile.

The self-expanding metallic stent (Figure 4) may reestablish patency of the occluded duct(s), allowing internal drainage of

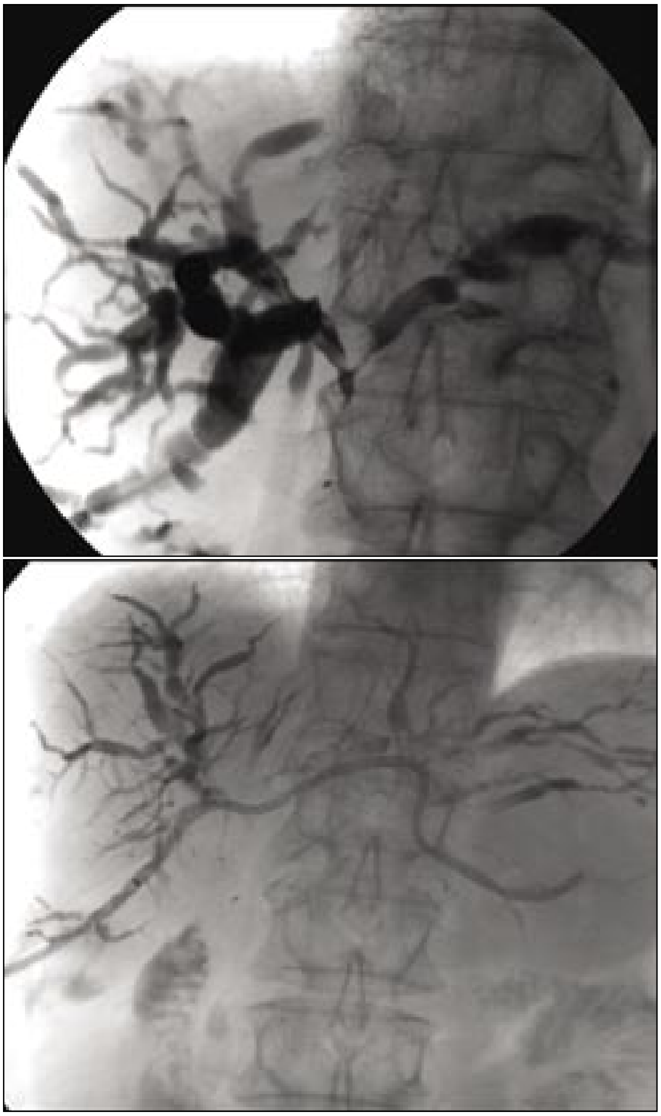

Figure 2 External Biliary Drainage Catheters

(**Top**) Right-sided biliary drainage in a patient with metastatic colorectal carcinoma demonstrates effective isolation of the right and left bile ducts. (**Bottom**) An external catheter was placed from the right to the left ducts to provide maximal drainage with a single catheter.

bile into the bowel without the need for an external device. However, because most metallic stents cannot be removed, most surgeons prefer that a metallic stent not be placed in patients who are potential surgical candidates.

Stents offer a limited mean patency of 6–10 months; for this reason, most practitioners reserve the use of metallic stents for patients with malignant disease and limited life expectancy.

THE PROS AND CONS OF METALLIC STENTS

When possible, internal stents should be considered, even in patients expected to outlive the stent. Placement of stents improves the quality of life of patients who are "catheter free" for only a few months. In addition, occluded stents may often be treated endoscopically without the need for a percutaneous catheter.

Figure 3 Internal-external Biliary Drainage Catheter

A right-sided biliary drainage catheter (arrow) drains the right and left (arrowhead) bile ducts in this patient with low biliary obstruction from pancreatic carcinoma.

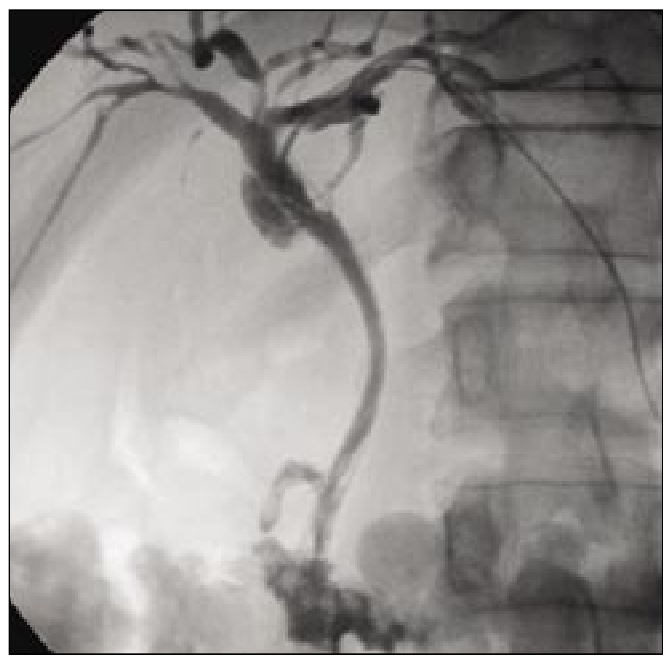

Figure 4 Self-expanding Metallic Stent

Common bile duct Wallstent in a patient with cholangiocarcinoma provides internal drainage of all bile segments.

In patients with longer life expectancy, stent placement may be appropriate if they understand that additional intervention is likely.[1,2] Stent placement in high bile duct obstruction may make further percutaneous intervention more difficult; therefore, stent placement should be performed only after all targeted segments have been drained.

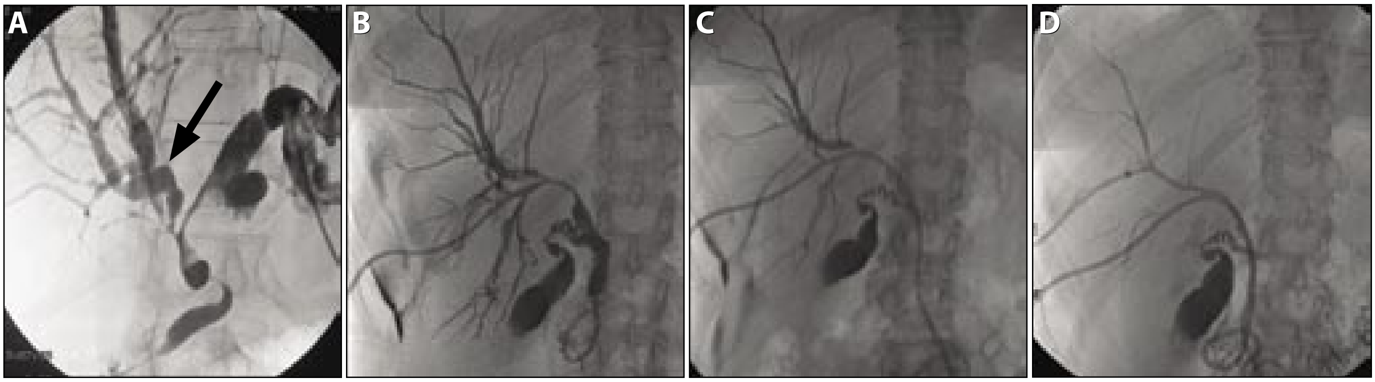

Figure 5 Different Types of Biliary Duct Isolation

(**A**) Left-sided biliary drainage in a patient with metastatic colorectal carcinoma demonstrates impending isolation of the right-sided bile ducts (arrow). (**B–D**) A right-sided biliary drainage was performed to lower the bilirubin level for chemotherapy in this patient with cholangiocarcinoma. There is complete isolation of the right and left bile ducts. In addition, the more cranial ducts opacified in (**B**) are not drained by the catheter (**C**) after aspiration. Because of ongoing cholangitis, this patient required drainage of this effectively isolated duct (**D**).

Unfortunately, stent placement is not possible in all patients due to the extent of isolation in the bile ducts, intraductal tumor, or outflow (duodenal or loop) obstruction. Results of preprocedure imaging may offer information about the level of obstruction and degree of isolation; however, these predictions are not always accurate, and the plan for drainage or stenting may also need changes based on cholangiographic findings. Therefore, all patients who undergo percutaneous biliary drainage should be made aware that they may need a life-long drainage catheter. In rare instances, the drainage may be abandoned altogether based on initial cholangiography.

Assessment for Drainage and/or Stent Placement

THE IMPACT OF "ISOLATION"

In cases of *complete* ductal isolation, the results of a patient's cholangiography show no opacification of the isolated system(s). In *effective* isolation, isolated ducts are opacified with contrast during direct cholangiography, but these ducts do not drain. Finally, in *impending* isolation, opacification and draining of biliary radical occur; however, central narrowing is likely to progress and cause effective or complete isolation in the foreseeable future (Figure 5). Unlike cases of completely isolated ducts, patients with effective or impending isolation have an increased risk of cholangitis, because their ineffectively drained bile ducts may be colonized during drainage.

When contrast material enters an impending or effectively isolated ducts, those ducts should be considered contaminated. If the obstruction does not extend beyond the secondary confluence, stents may be placed from the ipsilateral side to the contralateral side or from the ipsilateral side into the common bile duct or duodenum in a "T" configuration (Figure 6; left).

In some cases, the contralateral side may be punctured and side-by-side stents may be placed in a "Y" configuration (Figure 6; right). One advantage of this more anatomic "Y" placement is that the stents are both approachable endoscopically should stent occlusion occur. In addition, the patency rate of the "Y" configuration may be better in patients with type IV obstruction.[3]

Some authors suggest that survival is better with drainage of both sides of the liver,[4] although Inal et al[3] saw no significant difference in clinical response to treatment or stent patency rate with unilobar versus bilobar drainage, even in Bismuth type II and III hilar obstructions.

When possible, the stent is placed above the papilla to leave the sphincter function intact and to minimize the risk of reflux of intestinal contents into the biliary tree. If the occlusion extends low in the common bile duct, stenting to the duodenum is appropriate.[5] Stents may be placed in at the initial draiange in patients with type I or II obstruction with no increased risk of cholangitis at the time of initial drainage.[6]

More commonly, the isolated contralateral biliary tree is not opacified (complete isolation), precluding knowledge of the obstruction "type." Placement of primary stents in such patients is unusual, since more than one catheter may be needed for optimal drainage. In such cases, a "wait-and-see" approach may be preferred to gauge the therapeutic effect of the initial drainage.

If the same situation is seen in a patient being drained for pruritus relief alone, a primary stent could be placed; typically, only a small portion of the liver needs to be drained to palliate pruritus. However, these patients have other issues, the most common of which is the need to lower the bilirubin level to administer chemotherapy. When multiple self-expanding metallic stents are necessary, it is easier to place them simultaneously, rather than working through one (or more) that have been placed previously.

Because the right hepatic duct is short, central tumors often cause isolation of the anterior or posterior division. In this situation, further drainage likely will be required either to lower the serum bilirubin level or to treat cholangitis. If the left side cannot or should not be drained, as may occur with atrophy, then side-by-side self-expanding metallic

Figure 6 Configuration of Metallic Stents

(**Left**) "T" configuration of metallic stents extending from the right bile duct to the left and to the common bile duct. (**Right**) "Y" configuration of metallic stents draining the right and left bile ducts. Unlike the "T" configuration, placement of stents in this configuration requires two puncture sites.

stents may be placed on the right Figures 5b–d.

If the serum bilirubin level does not fall to an appropriate level, or if cholangitis develops, the left side can be drained; at that point, three stents may be placed to provide complete drainage. This approach may include stenting from the right anterior and posterior sectors to the common bile duct, from the right posterior or anterior sector to the left bile duct, or from the left duct into the common bile duct. Even a nonfunctional part of the liver must be drained occasionally to eliminate a source of ongoing cholangitis.

Patients with high bile duct occlusion that are drained to treat cholangitis probably should not be stented until all possible contaminated parts of the biliary tree are drained or until they are afebrile for at least 48 hours after discontinuing antibiotics. This will assure that no infected obstructed segments are left undrained only to require attention later. When obstruction extends to the segmental or subsegmental level, this problem can be challenging, and the only viable alternative may be to treat the patient with one or more drainage catheters and a course of rotating antibiotics.

At times, the degree of isolation is so extensive that it is virtually impossible to drain each isolated portion of the biliary tree. In those cases, an initial catheter is placed in the part of the liver believed to have the most connected bile ducts; additional catheters then are placed only to treat ongoing cholangitis. In such situations, it is not uncommon for the serum bilirubin to rise rather than fall after the initial catheter is placed.

In summary, the concepts behind biliary drainage are simple, although the execution is often challenging and time consuming when dealing with high bile duct obstruction. There is no proven difference in stent patency based on the level of obstruction or whether one or two stents are placed, and because lower complication rates have been reported when stents are placed in a one-stage procedure; thus, primary stent placement should be considered whenever possible.[6,7] Patients with type I or type II obstructions may be treated with a single stent, whereas patients with type III or IV obstructions may require the placement of multiple stents to achieve palliation.[3]

Postprocedure Care and Complications

Patients should be monitored carefully for 24 hours following drainage for signs of bleeding or sepsis. With proper technique, including peripheral bile duct puncture, serious bleeding complications are uncommon.

HEMOBILIA

Since the hepatic artery, portal vein, and bile ducts travel side by side within portal triads, it is not uncommon for blood to enter the bile duct during catheter exchanges, resulting in transient hemobilia. New or persistent hemobilia following catheter exchange is often due to a side hole of the device becoming positioned in an adjacent portal or hepatic vein branch; it can be corrected simply by repositioning the catheter. Occasionally, bleeding from the track may require upsizing of the catheter to tamponade the bleeding site.

Arterial injury should be suspected and the patient should be studied angiographically if bleeding develops 1–2 weeks or more following biliary drainage, especially when bleeding occurs suddenly and/or is detected around the catheter.[8] The more peripheral the bile duct punctured, the smaller the accompanying hepatic artery branch and the lower the risk of arterial injury resulting in postprocedure bleeding. Any abnormality of a hepatic arterial branch adjacent to the biliary drainage catheter should be considered as presumptive evidence of injury to the branch, and the vessel should be selectively embolized (Figure 7).

Figure 7 Abnormality of a Hepatic Arterial Branch

A patient with cholangiocarcinoma underwent bilateral biliary drainage procedures. Three weeks later the patient presented with new blood in and around the left-sided catheter. Hepatic angiogram (**top**) demonstrates a pseudoaneurysm of a left hepatic artery branch adjacent to the left drainage catheter (arrow). (**Bottom**) The pseudoaneurysm was successfully embolized with stainless steel coils (arrow).

INFECTION

Despite prophylactic antibiotic coverage, sepsis may be seen immediately following or within several hours of drainage.[9] Sepsis most commonly manifests as rigors and fever; hypotension may also occur. It is managed with intravenous antibiotics, expansion of intravascular volume, and pressor support as needed.

Blood and bile cultures may be used to identify organisms responsible for bacteremia and to tailor antibiotic therapy. Although positive bile cultures are more common among patients with benign bile duct obstruction, they also are positive in more than half of patients with malignant obstruction.

PERICATHETER LEAKAGE

Leaking of bile around a biliary drainage catheter is commonly due to catheter malposition, such that one or more side holes are no longer within the biliary tree, but in the catheter track or even outside the patient. Leakage may also be a sign of side-hole occlusion or a lack of side holes above the site of obstruction. In either case, the problem is often remedied easily by catheter exchange for a properly positioned catheter with an appropriate number of side holes above the obstruction.

Ascites may leak around the catheter, and when patients are jaundiced, the ascites may be bile-colored, causing it to be confused with bile. Leaking of ascites can be extremely difficult to manage and frustrating for patients. When possible, the best option is to internalize drainage with stent placement as expeditiously as possible. If the patient cannot be stented, the catheter can be upsized in attempt to tamponade the site, allowing time for track maturation. Unfortunately, leakage is likely to recur.

The ascites can be tapped frequently or drained via catheter to allow time for formation of a track to the skin. As a last resort, a stoma appliance may be applied around the entry site to contain the ascites.

Patients with internal-external biliary drainage catheters may undergo a "capping trial," in which the external portion of the catheter is capped to allow for internal drainage only. If the trial is successful, meaning the catheter is capped with no subsequent fever, leakage, or elevation of the serum bilirubin, the catheter may be left capped. Alternatively, if the goal of drainage has been achieved, the catheter may be exchanged for a stent. If the capping trial is not successful, patients should reopen the catheter to gravity drainage.

Summary

Treatment of malignant high bile duct obstruction presents unique challenges to the interventional radiologist. Outcomes depend on the symptom being treated, the condition of the underlying hepatic parenchyma, the degree of isolation of the biliary tree, and the skills and experience of the operator. A thorough understanding of functional biliary anatomy and high-quality pre-procedure imaging are necessary to optimize outcome.

Pruritus may be palliated easily with drainage of even one biliary segment. In high bile duct occlusion, biliary drainage is less successful in lowering the serum bilirubin level to normal or near-normal levels necessary to allow for certain chemotherapeutic regimens. In cases of effective or impending isolation, contamination of undrained parts of the biliary tree can result from drainage catheter placement and cause recurrent cholangitis. For this reason, biliary drainage in these patients should not be undertaken without a clear objective, and primary stent placement should be considered if a majority of the liver can be drained with one or two stents at the time of initial drainage.

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